

IN THE SPECIFICATION:

On page 60, lines 17-18, please replace the hypertext:

"http://www.corninfo.chem.wisc.edu/writings/DNA overview.html"

with the plain text: http://www.corninfo.chem.wisc.edu/writings/DNA overview.html--.

E1

Please replace the abstract on page 68 of the application with the abstract shown on the attached **replacement sheet for page 68**.

IN THE CLAIMS:

Please amend claims 9, 11, 15, 17, 22, 25, 27 and 28 as shown below:

54B1  
E2 9. (Amended) An analog, oligomer-based method for determining a mathematical result of carrying out an operation of matrix algebra on input data,

wherein single-stranded oligomers  $E_i$  and  $\underline{E}_i$  are a subset of all single-stranded oligomers and are each in 1:1 correspondence with the basis vectors  $e_i$ ,  $i = 1, 2, \dots, m$  in an abstract  $m$ -dimensional vector space;

wherein a set of the oligomers  $E_i$  and  $\underline{E}_i$  represents an  $m$ -component vector  $V = \sum_i V_i e_i$ , wherein the  $E_i$  and  $\underline{E}_i$  oligomers have complementary nucleotide sequences, with the  $E_i$  oligomers representing the  $i$ -th component of  $V$  for which the amplitude  $V_i$  is positive, and the  $\underline{E}_i$  oligomers representing the  $i$ -th component of  $V$  for which  $V_i$  is negative; and

wherein the concentration of each of the oligomers  $E_i$  or  $\underline{E}_i$  is proportional to the absolute value of the amplitude  $V_i$  of the  $i$ -th component of  $V$ ,

the method comprising the steps of

(1) obtaining a composition comprising at least one set of single-stranded oligomers  $E_i$  and  $\underline{E}_i$  representing the components of a vector, wherein the concentrations of the oligomers  $E_i$  or  $\underline{E}_i$  in the composition are proportional to the absolute values of the amplitudes of the components they represent, which composition represents input data; and

2) subjecting said composition to at least one physical or chemical treatment having an effect on said oligomers in said composition that is an analog representation of an operation of matrix algebra, and

(3) detecting the effect of said treatment on said oligomers in said composition to determine the analog result of carrying out said operation of matrix algebra on said input data;

wherein said analog result of carrying out said operation of matrix algebra on said input data is quantitatively dependent on the concentrations of said at least one set of single-stranded oligomers  $E_i$  and  $\underline{E}_i$  in said composition.

~~In claim 11, line 9 (in section (i)), replace "modifying" with -- phosphorylating or de-phosphorylating --.~~

~~In claim 11, lines 10 and 11 (in section (i)), delete "that does not add an additional oligomer subunit".~~

~~In claim 15, in lines 2 and 5, insert a space -- -- immediately before the "2" in "i = 1,2," to give "i = 1, 2".~~

~~In claim 22, in line 2, insert --of step (c) -- immediately after " $\underline{E}_i$ ".~~

17. (Amended) A method for obtaining a data set  $V_i^b$  from an oligomer-based, content-addressable memory following input of a data set  $U_i^b$  that represents a portion of  $V_i^b$ , wherein data elements in the form of m-component vectors  $V = \sum_i V_i e_i$  are represented in the memory by a set of the oligomers  $E_i$  and  $\underline{E}_i$  that are a subset of all single-stranded oligomers and are in 1:1 correspondence with the basis vectors  $e_i$  for  $i = 1, 2, \dots, m$  in an abstract m-dimensional vector space;

wherein oligomers  $E_i$  and  $\underline{E}_i$  have complementary nucleotide sequences, with  $E_i$  oligomers representing the i-th component of  $V$  for which the amplitude  $V_i$  is positive, and  $\underline{E}_i$  representing the i-th component of  $V$  for which  $V_i$  is negative; and wherein the concentration of each of oligomers  $E_i$  and  $\underline{E}_i$  is proportional to the absolute value of the amplitude  $V_i$  of the i-th component of  $V$ ;

the method comprising:

(a) preparing a content-addressable memory representing memory matrix  $T_{ij}$  in which are stored data sets corresponding to vectors  $V_i^a$  for  $a = 1$  to  $a = n$ , where  $i = 1, 2, \dots, m$ , wherein  $T_{ij}$  is the sum of all of the outer products  $V_i^a V_j^a$  for  $i \neq j$ ;

comprising obtaining for each vector  $V^a$  a set of single-stranded oligomers, each of which comprises a first single-stranded oligomer sequence selected from the group consisting of  $E_i$  or  $\underline{E}_i$  for each i-th component of  $V^a$  for  $i = 1$  to  $i = m$ , and further comprises a second single-stranded oligomer sequence selected from the group consisting of  $E_j$  or  $\underline{E}_j$  for each j-th component of  $V^a$  for  $j = 1$  to  $j = m$ , except for  $i = j$ ; and then pooling said sets of dimeric oligomers obtained for each vector  $V^a$  for  $a = 1$  to  $a = n$  thereby forming a set of oligomers representing a content-addressable memory;

(b) combining said pool of dimeric oligomers with a set of oligomers representing partial data set  $U_i^b$  under conditions wherein oligomer sequences  $E_i^b$  and  $\underline{E}_i^b$  of data set  $U_i^b$  hybridize specifically to complementary sequences  $E_j$  and  $\underline{E}_j$  present in said memory pool oligomers; and

obtaining an isolated set of monomeric oligomer strands  $X_i$  comprising the oligomer sequences  $E_i$  and  $\underline{E}_i$  of said memory pool oligomers that hybridized specifically to said  $U_i^b$  oligomers, wherein said  $X_i$  oligomers do not further comprise said  $E_j$  and  $\underline{E}_j$  sequences of said memory pool oligomers that are complementary to said  $U_i^b$  oligomers;

(c) combining said set of  $X_i$  oligomers with a set of single-stranded saturating oligomers comprising a set of  $E_i$  and  $\underline{E}_i$  oligomers representing the complete[, sub-stoichiometric] set of basis vectors  $e_i$  for  $i = 1$  to  $m$ , wherein the  $E_i$  and  $\underline{E}_i$  oligomers are sub-stoichiometric relative to said set of  $X_i$  oligomers, in that the number of  $X_i$  oligomers for at least one basis vector  $e_i$  is greater than the number of  $E_i$  or  $\underline{E}_i$  saturating oligomers corresponding to said basis vector, so that complementary sequences hybridize to each other, denaturing the resulting duplex molecules, and isolating the subset of  $X_i$  oligomer that hybridized specifically to said  $E_i$  and  $\underline{E}_i$  sequences, to obtain a set of saturated  $X_i$  strands,  $S(X_i)$ ;

(d) repeating steps (b) and (c) iteratively, using the set of saturated  $X_i$  strands,  $S(X_i)$  obtained in each previous implementation of step (c) as the set of oligomers representing partial data set  $U_i^b$  employed in the subsequent implementation of step (b), [to obtain a] until successive iterations yield the same set of oligomer strands  $X_i$  produced by step (b) that represents data set  $V_i^b$ .

25. (Amended) A content-addressable memory representing a memory matrix  $T_{ij}$  in which are stored data sets corresponding to vectors  $V_i^a$  for  $i = 1$  to  $i = m$ , wherein  $T_{ij}$  is the sum of all of the outer products  $V_i^a V_j^a$  for  $i \neq j$ ;

wherein data elements in the form of m-component vectors  $V = \sum_i V_i e_i$  are each represented in the memory by a set of the oligomers  $E_i$  and  $\underline{E}_i$  that are a subset of all single-stranded oligomers and are each in 1:1 correspondence with the basis vectors  $e_i$  for  $i = 1, 2, \dots, m$  in an abstract m-dimensional vector space;

wherein oligomers  $E_i$  and  $\underline{E}_i$  have complementary nucleotide sequences, with  $E_i$  oligomers representing the i-th component of  $V$  for which the amplitude  $V_i$  is positive, and  $\underline{E}_i$  representing the i-th component of  $V$  for which  $V_i$  is negative; and

wherein the concentration of each of oligomers  $E_i$  and  $\underline{E}_i$  is proportional to the magnitude of the amplitude  $V_i$  of the i-th component of  $V$ ; comprising:

a content-addressable memory representing memory matrix  $T_{ij}$  in which are stored data sets corresponding to vectors  $V_i^a$  for  $a = 1$  to  $a = n$ , where  $i = 1, 2, \dots, m$ ,

comprising a pool of dimeric, single-stranded oligomers comprising a set of dimeric oligomers for each vector  $V^a$ ,

wherein each oligomer in the set of oligomers for each vector  $V^a$  comprises a first single-stranded oligomer sequence selected from the group consisting of  $E_i$  or  $\underline{E}_i$  for each i-th component of  $V^a$  for  $i = 1, 2, \dots, m$ , and further comprises a second single-stranded oligomer sequence selected from the group consisting of  $E_j$  or  $\underline{E}_j$  for each j-th component of  $V^a$  for all  $j = 1$  to  $j = m$ , except for  $i = j$ .

27. (Amended) The method of claim 11 wherein said operation of matrix algebra is determining the inner product of two vectors  $[V_i] \underline{V}$  and  $[W_i] \underline{W}$  and said method comprises:

(i) obtaining for each vector  $[V_i] \underline{V}$  and  $[W_i] \underline{W}$ , sets of single-stranded oligomers  $E_i$  and  $\underline{E}_i$  representing the components of the vector, wherein the concentrations of the oligomers  $E_i$  and

$E_i$  are proportional to the absolute values of the amplitudes of the components they represent;

and

also obtaining a set of single-stranded oligomers  $E_i$  and  $\underline{E}_i$  representing the components of vector  $[W_i] \underline{W}$  that are complementary to said oligomers representing vector  $[W_i] \underline{W}$ , wherein the relative concentrations of the oligomers representing  $[W_i] \underline{W}$  are proportional to the concentrations of their complementary oligomers in  $[W_i] \underline{W}$ ,

wherein oligomers that represent components of said vectors  $V$ ,  $W$ , and  $\underline{W}$  having different basis vectors do not hybridize under conditions in which complementary oligomers  $E_i$  and  $\underline{E}_i$  corresponding to the same basis vector  $e_i$  do hybridize;

(ii) combining samples of the oligomers representing vector  $[V_i] \underline{V}$  with samples of the oligomers representing vectors  $[W_i] \underline{W}$  and  $[\underline{W}_i] \underline{W}$  in separate reaction mixtures and measuring the rates of hybridization of said mixtures, and obtaining a numerical value proportional to the inner product of the two vectors from said rates of hybridization.

28. <sup>Amended</sup> The method of claim 11 wherein said operation of matrix algebra is obtaining the inner product of a matrix and a vector, and

said method comprises

(a) obtaining a set of single-stranded oligomers representing matrix  $T$ , wherein each matrix component  $T_{ij}$  is represented by single-stranded oligomers comprising a dimeric oligomer sequence of the form 5'-A-B-3' selected from the group consisting of 5'- $\{E_i\} \{E_j\}$ -3', 5'- $\{E_i\} \{\underline{E}_j\}$ -3', 5'- $\{\underline{E}_i\} \{E_j\}$ -3', and 5'- $\{\underline{E}_i\} \{\underline{E}_j\}$ -3', and wherein the concentrations of said dimeric oligomers  $T_{ij}$  are proportional to the absolute values of the amplitudes of the matrix components they represent;